

State of Washington Department of Ecology
**Verification of Operating Conditions
of Advanced Wastewater Treatment
Systems for Cruise Ship Discharges**

Northwest Regional Office
3190 160th Ave SE
Bellevue, WA 98008
Phone: (425) 649-7000 Fax: (425) 649-7098

Puget Sound Field Office
1011 SW Klickitat Way, Suite 211
Seattle, WA 98134
Phone: (206) 389-2431 Fax: (206) 587-5196

Section A: General Information

Vessel Name:	DIAMOND PRINCESS	Date:	August 6, 2005
Vessel Operator:	Princess Cruises	Entry Time:	9:42 am
IMO Number:	9228198	Exit Time:	1:20 pm
Vessel Type:	Passenger Ship	Notification (name & date):	Charlie Ball/Dan Heverly 8/3/05
Location:	Terminal 30, Seattle	On-board contact(s):	Zeljko Sporanda, Environmental Officer; John Proatchard, System Operator; Brian Wattling, Chief Engineer; Domenico Lubrano Lavadera, Staff Captain
Inspector(s):	Amy Jankowiak (Ecology, Northwest Regional Office), Norm Davis (Ecology, Puget Sound Field Office)		
# passengers/crew:	Actual: ~2600/1100	Amount of Wastewater:	30m ³ /hr on average to Hamworthy
			Obtain copy of SMC: <input checked="" type="checkbox"/>

Description of advanced wastewater treatment system (name, type, major components, etc.):

Hamworthy is a biological reactor and ultrafiltration system. The system includes screening via a filter press, biological treatment via bio-reactors with inter-stage filters and a membrane system, and ultraviolet light disinfection. The system was installed in February of 2004. Approval for continuous discharge from Ecology was granted on May 5, 2005.

Section B: Areas Evaluated

<input checked="" type="checkbox"/>	Black/Gray wastewater system	<input checked="" type="checkbox"/>	Operations Center/ Computer system	<input checked="" type="checkbox"/>	Records/Reports	<input checked="" type="checkbox"/>	Sampling/Monitoring
<input checked="" type="checkbox"/>	Discharge locations	<input checked="" type="checkbox"/>	Operations & Maintenance	<input checked="" type="checkbox"/>	Sludge Handling/Disposal	<input checked="" type="checkbox"/>	Other (oil spill notification drill, debunking)

Section C: For vessels discharging ≥ 1 nm from berth and ≥ 6 knots only

<input type="checkbox"/>	Schematics match black/gray wastewater system	NA
<input type="checkbox"/>	Sludge disposal protocol per MOU	NA
<input type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance) in place	NA

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

<input checked="" type="checkbox"/>	Schematics match black/gray wastewater system	System appears to be as depicted in schematics.
<input checked="" type="checkbox"/>	Sludge disposal protocol per MOU	Yes. Sludge incinerated.
<input type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Notification procedures were not clear. They did not know the correct number to call. Information has been provided.
<input checked="" type="checkbox"/>	Operations as described in submitted documentation	Operations appeared to be as described in submitted documentation.
<input checked="" type="checkbox"/>	Daily 24-hour continuous turbidity or equivalent monitoring	Continuous turbidity monitoring
<input checked="" type="checkbox"/>	Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly.
<input type="checkbox"/>	<u>Turbidity or equivalent</u> Last calibration: Not sure, maybe done by Hamworthy Frequency of readings: continuous Trigger level for alarm: 60 NTU Recorded turbidity/equivalent levels above triggers: No	
<input checked="" type="checkbox"/>	Auto shut down or operational	Has not yet had alarm level reached, but protocol in place.

	controls to insure system shut down if a system upset occurs	
<input checked="" type="checkbox"/>	Ultraviolet (UV) light disinfection immediately prior to discharge	Yes.
<input checked="" type="checkbox"/>	UV replacement bulbs available	Yes. About 10 tubes available and 2-3 bulbs
<input checked="" type="checkbox"/>	UV/bulbs cleaned regularly	Yes via manual wipe down about monthly

Section E: General

<input checked="" type="checkbox"/>	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required.
<input checked="" type="checkbox"/>	Whole Effluent Toxicity Testing 1 per 2 years	WET testing not conducted yet. Only in 1 st season of approval.
<input checked="" type="checkbox"/>	Training up to date for system operators	Current operators, watch keepers and environmental officer trained.
<input checked="" type="checkbox"/>	Discharge records maintained	Maintained properly.
<input checked="" type="checkbox"/>	Alarms functioning properly	Alarms appear to be functioning properly.
	Alarms Shutdowns: Yes High turbidity warnings: Yes High wastewater levels: Yes UV disinfection (intensity, bulbs, bank out, power failure): Yes	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand (5-Day)	14.1 mg/l
Total Suspended Solids (TSS)	Non Detect
Fecal Coliform (MF)	1 CFU/100 ml
Residual Chlorine (if taken)	Non Detect
pH (if taken)	7.50 Standard Units
Other Turbidity	0.28 NTU

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist and Norm Davis, Ecology, Puget Sound Field Office, conducted the inspection on August 6, 2005. The main contacts on board the DIAMOND PRINCESS included Zeljko Sporda, Environmental Officer; John Proatchard, System Operator; Brian Watling, Chief Engineer; and Domenico Lubrano Lavadera, Staff Captain. Prior notification of the visit was given on August 3, 2005 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State*, as amended. Samples were also collected as per the MOU. The DIAMOND PRINCESS received approval to discharge continuously per the MOU on May 5, 2005.

The DIAMOND PRINCESS was built in February, 2004. It is 945 feet long with 18 decks and is about 60,000 tons, with a maximum ~28-foot draft. Passenger capacity is about 2600 and 1200 crew. The ship's wastewater system, Hamworthy, was installed at the time the ship was built in February of 2004.

Inspection

We arrived boarded the ship at about 9:45am and began with introductions and a plan for the day. A review of notification procedures for unauthorized discharges from the wastewater system was conducted as well. Staff were unaware of the correct phone number to contact for such discharges. The MOU requires "NWCA members to immediately self-report non-compliance with any provision of this MOU to the Department of Ecology at the following 24-hour number: 425-649-7000." The correct phone number was given to the Chief Engineer and a notification sheet is attached.

Next, we headed to the control room where the Hamworthy system is monitored from. John is the main system operator. The watch keepers (2nd engineer and 3rd engineer) also monitor the system. There is also a full-time person that maintains the system including cleaning, changing filters, etc. Training was initially done during the start-up of the plant. Books and staff training are also used. The Hamworthy computer system (photo # 5) allows for monitoring, alarms, and system

operational changes. The Hamworthy system operates in basically this sequence: screening via filter press, biological treatment via the bio-reactor with an inter-stage filter, ultrafiltration via the membrane system, and disinfection with ultraviolet light.

Blackwater is sent via vacuum to 5 different tanks. Galley graywater and laundry water is held and discharged outside of Washington waters and outside 4 nautical miles. Accommodation gray water is sent to about 20 different tanks and then to a gray water buffer tank. The Hamworthy system treats blackwater primarily and only pulls graywater if the levels allow for it. Any accommodation graywater that is not pulled through the system is held and discharged outside of Washington waters and outside 4 nautical miles. One of 3 Hamworthy systems pulls the blackwater and sometimes graywater into the system to the filter screen press. From there the liquid flow goes to the 1st stage of the bioreactor. Solids from the filter screen press are collected in bags and sent to the incinerator. Liquid from the 1st stage of the bioreactor goes to inter-stage screening. Solids collected there are sent to the inlet of the filter screen press. Liquids go on to the 2nd stage of the bioreactor. From there the liquid is pumped to the membranes. There are 24 membranes in each unit (72 total). At the time of the inspection 2 of the 3 units were online (48 membranes). One of the units was being looked at for performance. They have 14 spare membranes on the ship (3 of which are cracked). From the membranes, flow goes to a permeate collection tank and then onto holding tanks or UV disinfection and is then discharged.

Princess Cruises chooses to hold all discharges while in Washington waters even though they are approved to discharge continuously. In the control room, they have handy, updated charts (photo # 3) showing the cruising schedules and when and where discharges are to occur. When there are discharges, a procedure is followed which includes verifying from the bridge proper locations for discharges.

Turbidity is measured via a continuous meter located at the effluent of the membranes. Staff was unsure of the settings for the Turbidimeter alarms/shutdown levels, but after checking into it, discovered that there was one alarm level set at 60 NTU. The system does not automatically shutdown, however has operational control measures to ensure shutdown discharges from the system when the alarms go off. They have not yet reached the alarm level. The turbidity readings at the time that we were reviewing the control room computer systems read:

- 0.1 NTU in system no.1;
- 0.5 NTU in system no.2 (currently not on-line); and
- 23.8 NTU in system no. 3.

Staff stated that the turbidity meter usually reads at around 4.0 NTU. The level of 23.8 was of concern to staff. They believe that the higher reading is probably due to a dirty meter. Staff was unsure as to when the last calibration was conducted on the Turbidimeter. Hamworthy representatives are on the ship from time to time and may have calibrated the unit. Ecology recommends reviewing the manufacturer's requirements for calibration and calibrating the system on a regular basis. There are also concerns over the level set for the Turbidimeter alarms/shutdown. Through meetings and discussions with Princess Cruises, it is our understanding that the alarm/shutdown level would be set at a maximum of 30 NTU. Turbidity in correlation to total suspended solids is typically higher, therefore, it would be wise to set the level of the turbidity meters at a lower level than the TSS limit of 30 mg/l.

Other system monitoring includes weekly testing for: DO, COD, pH, coliform, chlorine, and BOD. Other tests are run once per day, unofficially as process control. The ship has its own laboratory (photo # 22) where some of the analysis can be run. Coliform testing is done on the ship. This attention to process control is commendable. There are alarms for turbidity, high tank levels, and UV disinfection.

The ultraviolet light disinfection system (UV) includes 1 unit with 6 tubes and 6 bulbs. The unit is alarmed. New tubes were put in about 4 months ago and are typically replaced about every 6 months. They have about 10 additional tubes and 2-3 bulbs available as replacements. Maintenance is done on the unit monthly and is cleaned manually via wipe down with cloths. Ecology would recommend reviewing the UV system manufacturer's recommendations for cleaning the UV system to be sure to prevent build-up.

Discharge records (photo # 4) were reviewed and are well kept. The records include dates, times, discharge locations, port locations, effluent type, volumes and flow rates (when known, some meters not yet installed), speed, signatures and remarks. The only copy of the MOU that could be found was a draft of the original version from April of 2004. The ship should have a copy of the up-to-date amended MOU on the ship. A copy is being sent electronically to the Chief Engineer.

Next we headed down to the Hamworthy system itself. John led us in a very informed tour of the system. Blackwater is collected to tanks (photo # 6 is one of 5). Accommodation graywater is collected into separate tanks (photo # 7 is one of about 20) and then goes to a graywater buffer tank (photo # 8). We looked at 1 of the 3 Hamworthy units, as they are identical. The blackwater and graywater are combined just prior to the filter screen press (photo # 9). Solids from the filter screen pressed are bagged (photo # 10), and the bags are replaced about every 4 hours. The bags are taken to the incinerator for incineration. The liquids move onto the 1st stage of the bioreactor (photo #13). Flow then moves to the inter-stage filters (photo # 11 and # 12) before moving to the 2nd stage of the bioreactor. Solids from these filters are sent back to

the inlet to the filter screen press. Liquid from the 2nd stage of the bioreactor is pumped (photo # 14) to the membranes (photo #15). The membranes have a clear area at the top for viewing (photo #16). Turbidity is measured at the effluent of the membranes (photo # 17). From there, flow goes to a permeate collection tank (photo # 18 and # 19) prior to the UV disinfection (photo # 20). There are two overboards for discharge, although only the port side is being used.

Samples were taken for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, and fecal coliform from the effluent of the UV disinfection. John disinfected the port with an alcohol spray prior to sampling for a clean sample. An Ecology turbidity meter was also used to run a turbidity sample right there. The result was 0.28 NTU. The samples were put on ice immediately and were transported to North Creek Analytical laboratory in Bothell, Washington that afternoon. Chain of Custody and sampling procedures were followed. All results are in Section F.

Hydrochloric acid and sodium hypochlorite (photo # 21) are stored in containment for pool use. We then observed some of the other waste streams on the ship. Garbage (photo # 23) is separated and disposed of on-shore or if allowed, per incineration. Hazardous waste is located in the hazardous waste storage area (photo # 24) where a log is kept. The waste is off-loaded on-shore for proper disposal or recycling. The ship has two incinerators for use (photo # 25). The laundry/dry cleaning services use detergents (photo # 26). While newer staff was unsure of the details of this waste stream, it is our understanding that the liquid does not go into the Hamworthy system, and is instead held and not discharged in Washington waters. The ship uses digital photography and some regular photography. Wastes from the photo area are collected and off-loaded on-shore. The medical facility does not have any discharges to the Hamworthy system, and off-loads wastes on-shore for disposal. There have not been any norovirus outbreaks this season on the ship. Non-contact hand cleaning dispensers are reportedly located in various places on the ship.

Conclusions and Recommendations

The Hamworthy system appears to be functioning well with the exception of occasional higher turbidity levels. The ship apparently has not had any turbidity levels requiring the shutdown of the discharges, but has a protocol to do so if needed. The ship is also choosing to hold its discharges in Washington waters even though they are approved for proper discharges.

It is recommended that turbidity alarm settings for shutdown be set to 30 NTU or less to ensure that undesirable quality of effluent would not be discharged. The Turbidimeter should also be calibrated regularly.

The staff was generally knowledgeable of the system. We would recommend that as new staff cover the system, that they receive appropriate training and achieve comparable levels of proficiency.

It is recommended that the UV system cleaning procedures be reviewed and that cleaning be done per manufacturer's recommendations. This practice may be increasingly important as the bulbs' intensity decreases with age.

A copy of the most current MOU should be readily available to all staff. Notification procedures for MOU noncompliance should be known and easily available by all relevant staff including the system operators and staff making the notifications. Princess Cruises should pass the word on about the notification phone # and protocol to all Princess ships that travel to Washington waters.

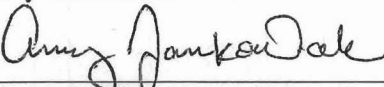
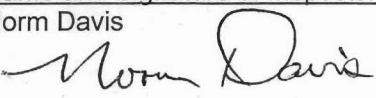
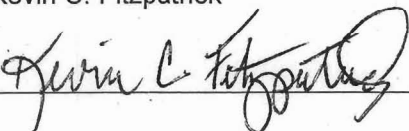
Attachments:

- Photographs
- Ship particulars
- Safety Management Certificate
- Sampling Results Report
- Notification sheet

Copies to:

- George Wright, Princess Cruises
- Charlie Ball, Princess Cruises
- Zeljko Sporanda, Environmental Officer
- John Proatchard, System Operator
- Brian Wattling, Chief Engineer
- Domenico Lubrano Lavadera, Staff Captain
- Amy Jankowiak, Ecology
- Norm Davis, Ecology
- Frank Meriwether, Health
- Kevin Fitzpatrick, Ecology
- Central Files: Princess Cruise Line – DIAMOND PRINCESS; WQ 6.1

Section H: Signatures

<u>Name and Signature of Inspector</u> Amy Jankowiak 	<u>Agency/Office/Telephone</u> Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	<u>Date</u> 8/22/05
<u>Name and Signature of Inspector</u> Norm Davis 	<u>Agency/Office/Telephone</u> Department of Ecology/Puget Sound Field Office/(206) 389-2438	<u>Date</u> 8/26/05
<u>Name and Signature of Reviewer</u> Kevin C. Fitzpatrick 	<u>Agency/Office/Telephone</u> Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	<u>Date</u> 8/30/05



State of Washington Department of Ecology
**Verification of Operating Conditions
of Advanced Wastewater Treatment
Systems for Cruise Ship Discharges**

Northwest Regional Office
3190 160th Ave SE
Bellevue, WA 98008
Phone: (425) 649-7000 Fax: (425) 649-7098

Section A: General Information

Vessel Name:	OOSTERDAM	Date:	September 10, 2005
Vessel Operator:	Holland America Line	Entry Time:	12:36 pm
IMO Number:	9221281	Exit Time:	2:45 pm
Vessel Type:	Passenger Ship	Notification (name & date):	Daniel Grabb 9/7/05
Location:	Pier 30, Seattle	On-board contact(s):	Kevin Baker, Environmental Officer; Cornelis Van Der Weele, system operator; Frank DeVries, First Officer John Turvey, Auditing/Coordination Manager
Inspector(s):	Amy Jankowiak, Department of Ecology; Kevin Fitzpatrick, Department of Ecology; Frank Meriwether, Department of Health – Shellfish Program		
# passengers/crew:	Actual: ~1800/~650	Amount of Wastewater:	GW ~ 34m ³ /hr; BW ~ 14m ³ /hr
		Obtain copy of SMC:	NA <input type="checkbox"/>

Description of advanced wastewater treatment system (name, type, major components, etc.):

Rochem Advanced Waste Water Purification System. The Rochem greywater system includes prefiltration, reverse osmosis and UV disinfection. The Rochem blackwater system includes prefiltration, biological treatment via bioreactors, ultrafiltration, and UV disinfection.

Approval for discharge at greater than 1 nautical mile away from port and at greater than 6 knots from Ecology was granted in July 2004.

Section B: Areas Evaluated

<input type="checkbox"/>	Black/Gray wastewater system	<input checked="" type="checkbox"/>	Operations Center/ Computer system	<input checked="" type="checkbox"/>	Records/Reports	<input checked="" type="checkbox"/>	Sampling/Monitoring
<input checked="" type="checkbox"/>	Discharge locations	<input checked="" type="checkbox"/>	Operations & Maintenance	<input checked="" type="checkbox"/>	Sludge Handling/Disposal	<input checked="" type="checkbox"/>	Other

Section C: For vessels discharging ≥ 1 nm from berth and ≥ 6 knots only

<input checked="" type="checkbox"/>	Schematics match black/gray wastewater system	Yes.
<input checked="" type="checkbox"/>	Sludge disposal protocol per MOU	Yes. Protocol for discharges sludge is at greater than 12 nautical miles from shore and outside of the Olympic Coast National Marine Sanctuary.
<input checked="" type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance) in place	Procedures for notification per the MOU was known and available. A notification sheet was also handed to staff on board. A copy of the most recent MOU was also available.

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

<input type="checkbox"/>	Schematics match black/gray wastewater system	Not Applicable
<input type="checkbox"/>	Sludge disposal protocol per MOU	Not Applicable
<input type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Not Applicable
<input type="checkbox"/>	Operations as described in submitted documentation	Not Applicable
<input type="checkbox"/>	Daily 24-hour continuous turbidity or equivalent monitoring	Not Applicable
<input type="checkbox"/>	Turbidimeter or equivalent monitoring equipment functioning properly	Not Applicable
	<u>Turbidity or equivalent</u> : Not applicable Last calibration Frequency of readings: Trigger level for alarm: Trigger level for shutdown: Recorded turbidity/equivalent levels above triggers:	
<input type="checkbox"/>	Auto shut down or operational controls to insure system shut	Not Applicable

	down if a system upset occurs	
<input type="checkbox"/>	Ultraviolet (UV) light disinfection immediately prior to discharge	Not Applicable
<input type="checkbox"/>	UV replacement bulbs available	Not Applicable
<input type="checkbox"/>	UV/bulbs cleaned regularly	Not Applicable

Section E: General

	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required.
	Whole Effluent Toxicity Testing 1 per 2 years	WET testing not conducted yet. In second season of approval.
	Training up to date for system operators	There is an extensive training program including computer based and detailed handovers.
	Discharge records maintained	Maintained properly.
<input checked="" type="checkbox"/>	Alarms functioning properly	Alarms appear to be functioning properly.
	<u>Alarms</u> Shutdowns: not applicable High turbidity/TSS warnings: yes High wastewater levels: yes UV disinfection (intensity, bulbs, bank out, power failure): yes	

Section F: Sample Results

Parameter	Effluent Result	
Biochemical Oxygen Demand 5-Day (mg/l)	BW: 27.1	GW: 112
Total Suspended Solids (mg/l)	BW: Non Detect	GW: Non Detect
Fecal Coliform, MF (CFU/100 ml)	BW: 10	GW: Not taken
Residual Chlorine (mg/l)	BW: Non Detect	GW: Non Detect
pH (standard units)	BW: 7.31	GW: 7.59
Other: Turbidity (NTU)	BW: 0.77	GW: 0.23

Laucks Testing Laboratories, Inc was also on board pulling samples.

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program (NWRO-WQ), Municipal Compliance Specialist and Kevin Fitzpatrick, Ecology NWRO-WQ, Water Quality Program Section Manager, and Frank Meriwether, Washington State Department of Health – Shellfish Program, Environmental Engineer conducted the inspection on September 10, 2005. The main contacts on board the OOSTERDAM included John Turvey, Auditing/Coordination Manager, Kevin Baker, Environmental Officer, Cornelis Van Der Weele, system operator, and Frank DeVries, First Officer. Prior notification of the visit was given on September 7, 2005 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State*, as amended. The OOSTERDAM received approval to discharge at greater than one nautical mile away from port and at greater than six knots in July 2004.

The OOSTERDAM (photo #1) was built in 2002, and is 936 feet long with a width of 106 feet and a maximum draft of 26 feet. There are typically about 1800 passengers and about 650 crew. The ship's wastewater systems, Rochem, was installed in 2002.

Inspection

We arrived boarded the ship at about 12:36 pm and began with introductions and a plan for the day. We then headed to the control room where the Rochem systems are monitored. Mr. Van Der Weele, system operator, walked us through the Rochem wastewater systems on the computers (photos #2, #3, #4, and #5). Both Mr. Van Der Weele and Mr. Baker seemed very familiar with the system. Mr. Van Der Weele is basically operating the system or is on call. Other engineers also monitor the system. Training is conducted through staff during handovers as well as computer-based training. The Rochem greywater system operates in basically this sequence: prefiltration, reverse osmosis and UV disinfection. The Rochem blackwater system includes prefiltration, biological treatment via bioreactors, ultrafiltration, and UV disinfection.

Initially, it was stated that this ship was not discharging at all into Washington waters even though they were approved to do

so at greater than 1 nautical mile away from port and greater than 6 knots. They have the capacity of 48-50 hours of holding time at typical wastewater flows and are in Washington waters for approximately 10-12 hours maximum. The First Officer later clarified to us that this ship does discharge in Washington waters. A protocol for discharging includes checking geographical locations with the bridge and getting permission from the bridge to discharge. It should be very clear to all staff that in Washington waters, discharges are only allowed at greater than "one nautical mile away from its berth at a port in Washington and is traveling at a speed of at least 6 knots" per the MOU.

Discharge records were reviewed and are well kept (photos #6 and #7). The "Sewage and Gray Water Discharge Record Book" includes dates, times, discharge locations, port locations, effluent type, volumes, speed, signatures and remarks.

Sludge from the system is sent to holding tanks and is then discharged at greater than 12 nautical miles from shore and outside of the Olympic Coast National Marine Sanctuary. All GW biosolids are incinerated.

A review of notification procedures for unauthorized discharges from the wastewater system was conducted. The MOU-required notifications procedures were known by staff during the inspection (The MOU requires "NWCA members to immediately self-report non-compliance with any provision of this MOU to the Department of Ecology at the following 24-hour number: 425-649-7000."). A quick reference notification sheet was provided as attached. The ship has access to the most current version of the amended MOU.

A discussion of both the graywater and blackwater systems and a walk-through of each of the systems was conducted:

Graywater System:

The maximum allowed TSS for the GW system is 10 mg/l. Higher levels shut down the treatment system until the problem is fixed.

Laundry water, swimming pool water, and passenger shower/sink wastewater goes into the graywater holding tank (photo #8) (165 m³) and is sent (photo #9) to the low pressure reverse osmosis (LP-RO) treatment system. The graywater is dechlorinated prior to entering prefiltration due to swimming pool and cleaning. After dechlorination, the flow enters prefiltration (photos #10 and #11) and then goes to the LP-RO units (photos #13 and #14). Screenings from the prefiltration are collected (photo #12) and sent to incineration. The LP-RO system consists of 4 different units. The number of units used can be changed depending on need. The pore size in this LP-RO system is reported to be about 0.001 microns, which is smaller than viruses. Effluent from the LP-RO system goes to a permeate tank (photo #15) and then onto ultraviolet (UV) disinfection (photo #16). PH is adjusted with sodium acid and caustic soda. From UV, the flow can either go straight overboard or can go to storage tanks.

During our visit the GW turbidity reading was 7 FNU (after UV). No one (including us) knew the relationship between FNU and NTU units. It turns out there is no established relationship between NTUs and FNUs (Formazin Nephelometric Units) because NTUs are measured with white light and FNUs are measured with an infrared light and suspended particles scatter light of different wavelengths differently.

There are separate UV disinfection systems for the BW and GW. There is a sampling port at the head of both the BW and the GW UV disinfection systems. There are eight or ten bulbs in the GW UV disinfection system, all in one bank. The bulb sleeves are manually cleaned once per month, and the bulbs are changed once each year (this is in agreement with the manufacturer's recommendation to change bulbs every 8000 hours of use). There is no intensity monitor with this UV system, but each bulb has a monitor that shows if the bulb is on or off. Extra UV bulbs are on board.

Blackwater System:

Typical TSS levels in the blackwater bioreactor system are 15 mg/l even though this system is anoxic. The maximum allowed TSS in the treated BW effluent is 25 mg/l. At that level the system shuts down until the problem is resolved (like a dirty sensor). There is a TSS monitor and a turbidity sensor for the treated BW. At 1440 the final BW effluent had a turbidity of 1.9 FNU.

Toilet waste, Galley waste, infirmary drains and crew waste goes to (photo #20) a buffer tank (photo #21) and then onto the blackwater treatment system (Rochem UF; ultrafiltration). From the buffer tank, flow goes to prefiltration (photos #22, and #23-spare screen). Solids are vibrated out and sent to incineration. PH is adjusted with caustic soda after prefiltration. Liquid from the prefiltration filtrate tank (photo #24) goes to the bioreactors. From the bioreactors (photo #25), flow goes through the membranes for ultrafiltration (UF). According to information from Rochem, the pore size on its UF system is about 0.025 microns, which is close to the middle of the range of diameter sizes for viruses. Effluent from the membranes is disinfected via a separate UV system (photos #26 and #27). There is a sampling port at the head of both the BW and the GW UV disinfection systems. There are eight bulbs in the single bank of the BW UV (Aquafine®) disinfection system.

Effluent streams from both the blackwater and the graywater are discharged out of the ship from the same port (B).

Ecology recommends that the manufacturer's recommendations for cleaning the UV be reviewed and followed. Proper cleaning may be increasingly important as the bulbs' intensity decreases with age.

Samples were taken (photos #18, and #28) for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, and fecal coliform from the effluent of the UV disinfection for both blackwater and graywater (with the exception of fecal coliform for graywater – Ecology ran out of sample containers). An Ecology turbidity meter was also used to run a turbidity sample right there for both blackwater and graywater. The result was 0.77 NTU (photo #29) for blackwater and 0.23 NTU (photo #19) for graywater. The samples were put on ice immediately and were transported to North Creek Analytical laboratory in Bothell, Washington that afternoon. Chain of Custody and sampling procedures were followed. All results are in Section F.

We then observed some of the other waste streams on the ship. The laundry (photo #30) uses detergents and discharges to the graywater system. Dry cleaning uses PERC which is collected (photo #31) and sent off of the ship as hazardous waste. Hazardous wastes are collected, labeled, stored (photo #32) and then sent to shore for proper disposal. Garbage/recycling is sorted (photos #33 and #34) sent to shore.

The ship has a BioVir virus testing kit (photo #35) sent by David Wetzel of Admiralty Environmental in case of a Norovirus illness outbreak.

Conclusions and Recommendations

The Rochem systems appeared to be functioning well.

It should be very clear to all staff that in Washington waters, discharges are only allowed at greater than "one nautical mile away from its berth at a port in Washington and is traveling at a speed of at least 6 knots" per the MOU.

The staff was generally knowledgeable of the system. We would recommend that as new staff cover the system, that they receive appropriate training and achieve comparable levels of proficiency.

In case of a Norovirus illness outbreak, the environmental staff are expected to call David Wetzel for sampling instructions. Dr. Wetzel has informed DOH (Frank Meriwether) that he would suggest to ship staff, that virus sampling include a sampling point immediately prior to UV disinfection. Frank Meriwether can be reached at (360) 236-3321 for any questions regarding virus sampling.

Attachments:

Photographs

Notification Sheet

Ship information (provided by Holland America)

Sampling Results Report

Copies to:

Daniel Grabb, HAL

Dan Grausz, HAL

John Turvey, HAL

Kevin Baker, HAL

Cornelis Van Der Weele, HAL

Amy Jankowiak, Ecology

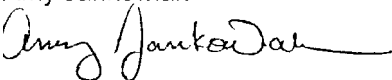
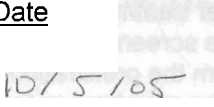
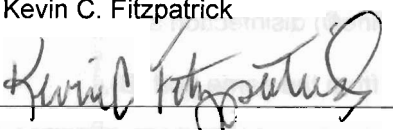
Norm Davis, Ecology

Frank Meriwether, Health

Kevin Fitzpatrick, Ecology

Central Files: Holland America Line; OOSTERDAM; WQ 6.1

Section H: Signatures

<u>Name and Signature of Inspector</u> Amy Jankowiak 	<u>Agency/Office/Telephone</u> Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	<u>Date</u> 
<u>Name and Signature of Reviewer</u> Kevin C. Fitzpatrick 	<u>Agency/Office/Telephone</u> Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	<u>Date</u> 10/7/05

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

Northwest Regional Office
3190 160th Ave SE
Bellevue, WA 98008
Phone: (425) 649-7000 Fax: (425) 649-7098

Puget Sound Field Office
1011 SW Klickitat Way, Suite 211
Seattle, WA 98134
Phone: (206) 389-2431 Fax: (206) 587-5196

Section A: General Information

Vessel Name:	NORWEGIAN DREAM	Date:	July 21, 2005
Vessel Operator:	NCL (Bahamas) Ltd.	Entry Time:	9:46 am
IMO Number:	9008419	Exit Time:	1:58 pm
Vessel Type:	Passenger Ship	Notification (name & date):	Randy Fiebrandt/Eric Wolff 7/14/05
Location:	Pier 66, Seattle	On-board contact(s):	Rune Bendicksen (outgoing Env. Officer); Bjorn Foss (current Env. Officer); Gilbert Ramirez (Wastewater System Operator)
Inspector(s):	Amy Jankowiak (Ecology), Captain Guy Grayson (Ecology), Frank Meriwether (Dept of Health), John Williams (Ecology)		
# passengers/crew:	Actual: ~1800/~800	Amount of Wastewater:	Yesterday: 848m ³ /day
			Obtain copy of SMC: <input checked="" type="checkbox"/>

Description of advanced wastewater treatment system (name, type, major components, etc.):
Scanship is a biological reactor and ultrafiltration system. The system includes prefiltration, biological treatment via a biofilm process, chemical precipitation, clarification through flotation tanks, polishing filtration and UV disinfection. The system was installed about 2 months prior. Approval for continuous discharge from Ecology was granted on June 27, 2005.

Section B: Areas Evaluated

<input type="checkbox"/>	Black/Gray wastewater system	<input type="checkbox"/>	Operations Center/ Computer system	<input checked="" type="checkbox"/>	Records/Reports	<input checked="" type="checkbox"/>	Sampling/Monitoring
<input checked="" type="checkbox"/>	Discharge locations	<input checked="" type="checkbox"/>	Operations & Maintenance	<input checked="" type="checkbox"/>	Sludge Handling/Disposal		Other (oil spill notification drill, debunking)

Section C: For vessels discharging ≥ 1 nm from berth and ≥ 6 knots only

<input type="checkbox"/>	Schematics match black/gray wastewater system	NA
<input type="checkbox"/>	Sludge disposal protocol per MOU	NA
<input type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance) in place	NA

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

<input checked="" type="checkbox"/>	Schematics match black/gray wastewater system	System is as depicted in schematics
<input checked="" type="checkbox"/>	Sludge disposal protocol per MOU	Discharges 12 nm out. Two sludge tanks
<input type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Notification procedures were not clear. The ship did have a copy of the MOU and states that the information is in the SEMS system, but the notifications are made from the bridge and they were unable to locate the proper number. Per their okay, I wrote the correct phone number on their call out sheet in their notification manual.
	Operations as described in submitted documentation	Operations were as described.
	Daily 24-hour continuous turbidity or equivalent monitoring	Has continuous TSS monitoring
<input checked="" type="checkbox"/>	Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly. Details in narrative.
	<u>Turbidity or equivalent</u> Last calibration: once/week Frequency of readings: Continuous Trigger level for alarm: 20 mg/l TSS Recorded turbidity/equivalent levels above triggers: yes	
<input checked="" type="checkbox"/>	Auto shut down or operational	Automatic shutdown appears to be operating properly.

	controls to insure system shut down if a system upset occurs	
	Ultraviolet (UV) light disinfection immediately prior to discharge	3 UV banks that run in series. ~40W/M ² . There is a holding tank available after UV. Flow that goes to the holding tank is only discharged out at Sea.
<input checked="" type="checkbox"/>	UV replacement bulbs available	Only 1 bulb on the ship
<input checked="" type="checkbox"/>	UV/bulbs cleaned regularly	Auto cleans every 100 hours via water pumping through and a chemical wash. Wiping of the bulbs is not practiced.

Section E: General

	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required.
	Whole Effluent Toxicity Testing 1 per 2 years	WET testing not conducted yet. Only in 1 st season of approval.
<input checked="" type="checkbox"/>	Training up to date for system operators	Scanship conducts training on the ship during start-up of the system. A certificate is issued to those trained. Gilbert has completed training, but hasn't yet received his certificate. 2-3 other staff have also been trained.
<input checked="" type="checkbox"/>	Discharge records maintained	Maintained properly
<input checked="" type="checkbox"/>	Alarms functioning properly	Alarms appear to be functioning properly.
	<u>Alarms</u> Shutdowns: yes High turbidity/TSS warnings: yes High wastewater levels: yes UV disinfection (intensity, bulbs, bank out, power failure): yes	

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand (5-Day)	21.2 mg/l
Total Suspended Solids (TSS)	Non Detect
Fecal Coliform (MF)	Non Detect
Residual Chlorine (if taken)	0.0940 mg/l
pH (if taken)	6.67 Standard Units
Other Turbidity	2.16 NTU

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist; Captain Guy Grayson, Ecology, Puget Sound Field Office, Vessel Inspector; John Williams, Ecology; and Frank Meriwether, Washington State Department of Health – Shellfish Program, Environmental Engineer conducted the inspection on July 21, 2005. The main contacts on board the NORWEGIAN DREAM included Rune Bendicksen, the outgoing Environmental Officer, Bjorn Foss the current Environmental Officer, and Gilbert Ramirez, the main wastewater system operator. Prior notification of the visit was given on July 14, 2005 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State*, as amended. The NORWEGIAN DREAM received approval to discharge continuously per the MOU on June 27, 2005. An oil spill notification drill and bunkering evaluation were also conducted by Captain Grayson. Samples were also collected.

The NORWEGIAN DREAM was built in 1991 and expanded by 40 meters in 1998. It is 754 feet long with 13 decks and is just over 50,000 tons, with a minimum 22-foot draft. Passenger capacity is 2156 with all berths filled. On the day of the inspections, they had approximately 1800 passengers and 800 crew. The ship's wastewater system, Scanship, was installed about two months prior.

Inspection

We arrived boarded the ship at about 10:00am and began with introductions and headed to the bridge for the notification drill. The drill was then conducted. A review of notification procedures for unauthorized discharges from the wastewater system was conducted as well. Staff were unaware of the correct phone number to contact for such discharges. The MOU requires "NWCA members to immediately self-report non-compliance with any provision of this MOU to the Department of Ecology at the following 24-hour number: 425-649-7000." A review of the notification manual did not include this number. Per staff's

okay, I wrote the phone number on the call sheet in the manual.

The ship's computerized navigation system shows the ship's location in near field with labeled landmarks including the shipping lanes. However, they navigate via paper maps and waypoints for accuracy.

Next, we headed to the medical facility. The facility's sharps, used narcotics and other medical materials are sent on shore for proper disposal, and not sent to the wastewater system. X-ray waste is sent to the silver recovery system in the photo lab. Non-contact hand cleaning dispensers are located in various places on the ship including the medical facility and the food areas. On the average, about six people per day report to the ship's doctor. There has not been any norovirus outbreaks this season on the ship. We then went to the printing/photo area. Printing waste is collected in a bucket and taken to shore. A silver recovery system is used where drums collect the waste stream and the silver is sent to shore (photos #3 and #4). They collect approximately 1 drum worth per cruise. The laundry area was visited next. The laundry system discharges to the wastewater system. PERC is used, filtered out and collected for disposal on shore (photo #5).

We then arrived at the control room where Captain Grayson worked with staff on bunkering. Ms. Jankowiak and Mr. Meriwether began reviewing the Scanship system and records. Mr. Ramirez walked us through the Scanship wastewater system on the computer. Mr. Ramirez seemed very familiar with the system. He is basically on call or operating the system the whole time he is on board. He does some basic cleaning of some of the Scanship components, monitors the system, but does not use test kits for process control such as settleability or MLSS concentrations. System maintenance includes filter cleaning and manual prefiltration cleaning daily with water pressure. The Scanship computer system allows for monitoring, alarms, and system operational changes (photo #6 and #9)). The Scanship operates in basically this sequence: prefiltration, biostep (biofilm on rotating plastic pieces), chemical precipitation (coagulant, polymer), clarification via flotation tanks, ultrafiltration via rotating mesh drums, and disinfection via ultraviolet light.

An online continuous TSS monitor is used to measure the turbidity of the effluent. An alarm level is set at 20 TSS and another at 30 TSS which triggers the automatic shutdown of discharges and recycles the flow back through the system. When we first arrived in the control room (About 11:30 am), the TSS monitor was reading at 47.6 mg/l and the system had automatically shutdown the discharge and was redirecting the effluent to the beginning of the system. By 12:20 pm, the TSS were between 5 and 6 mg/l and the system was discharging. When asked if the system goes above 30 TSS often requiring shutdown, Mr. Ramirez said that it does not happen a lot, but does occur from time to time. He mentioned that the variety in flow, especially when at Port and offloading/onloading passengers may be a cause for the elevated TSS levels. Also, the TSS can go so high in this system, and go up and down so quickly, because the high TSS levels are due to an "overflow" within the system. According to the computer's report log, these overflows happen somewhat frequently. At the same time that the TSS was elevated, the UV intensity levels were lower. The UV levels also improved as the TSS improved. The lower UV levels seem to be a reaction from the higher TSS levels since the "overflow" goes through UV disinfection before being routed back to the head of the treatment system.

The UV bulbs/sleeves are washed automatically via a pump wash with a solution like "Metal Bright" every 100 hours. There are no wipers for the UV sleeves and they have not been hand-cleaned. Mr. Ramirez wasn't aware of the manufacturer's recommendation for hand-cleaning (Mr. Meriwether found this in their manual – photo #8)). The UV system is alarmed. The ship only has one bulb replacement on board. Having additional replacement bulbs is necessary. Effluent from the UV disinfection typically discharges directly overboard from there, however, there are clean water holding tanks for effluent that are sometimes used. When asked what happens with the effluent from the clean water holding tanks, Mr. Ramirez stated that the effluent is only discharged in open sea. It is important to note that the waters subject to the MOU include waters that are greater than three nautical miles from shore in places. Effluent is only allowed to be discharged from the AWTS if UV disinfection is done immediately prior to discharge (to prevent bacterial re-growth).

Sludge from the system is sent to holding tanks and is then discharged at greater than 12 nautical miles from shore. Per the MOU, the discharge of sludge is also prohibited within the "Area To Be Avoided" off the Washington Coast in the Olympic Coast National Marine Sanctuary. We were informed that the last dumping of sludge was in the Prince Rupert area.

Scanship conducts training on the ship during start-up of the system. A certificate is issued to those trained. Mr. Ramirez has completed training, but hasn't yet received his certificate. Mr. Ramirez stated that 2-3 other staff have also been trained on the system.

Discharge records were reviewed and are well kept. The records include discharge locations in latitude and longitude for discharges prior to continuous discharge approval. After that point, it is apparently more difficult to track the exact location of the discharges since they occur continuously, so the records show the approximate location of the ship during periods of discharge. The records include dates, times, discharge locations, port locations, effluent type, volumes, flow rates, speed, signatures and remarks (photo #7).

The protocol for discharge includes having only the one person on duty with the means to unlock the discharge ports for

discharge (I believe this is either the environmental officer or the engineer on duty). The discharge valves are chained shut and padlocked. Prior to unlocking the discharge ports, the ship's position is checked.

Next we headed down to the Scanship system itself. Mr. Ramirez led us in a very informed tour of the system. Graywater and blackwater from the ship are collected in a tank (photo #10). There are two prefilter screens (about 350 microns – photo #11 and #12) followed by defoaming (generally only lightly used on occasion). **No solids or plastics were visible on the screen, so wastewater may be screened prior to these prefilters.** The prefilters are cleaned manually every day with hot water. From there the liquid goes to the biological treatment via a biofilm tank (photo #13 and #14), then coagulant and polymer are added (photo #15 and #16) prior to clarification via two flotation tanks (photo #17 through #21) that are on a system that allows the tanks to stay level so as the ship tilts, the tanks are essentially still. After flotation the liquid goes to one of two polishing filters (photo #22 and #23) for ultrafiltration via a mesh size of about 30µm. From the filters, the liquid goes to the ultraviolet disinfection (photo #24) and is then typically discharged directly (photo #25). There are sampling ports at the effluent of the UV (photo #26) and there are sampling locations available prior to disinfection. These ports could be used to collect potential samples for the Norovirus (in case of an outbreak) in order to test for Norovirus removal efficiency of the AWTS. Solids are taken from the prefiltration screens and from the flotation units to a sludge tank.

Samples were taken for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, and fecal coliform from the effluent of the UV disinfection. Mr. Ramirez heated the port prior to sampling for a clean sample. An Ecology turbidity meter was also used to run a turbidity sample right there. The result was 2.16 NTU. The samples were put on ice immediately and were transported to North Creek Analytical laboratory in Bothell, Washington that afternoon. Chain of Custody and sampling procedures were followed. All results are in Section F.

Conclusions and Recommendations

The Scanship system appears to be functioning well with the exception of occasional high TSS levels. The automatic shutdown during high TSS levels appears to be functioning properly **as was seen during the inspection.** **The cause of the high TSS levels does not appear to be well understood.** It is recommended that a closer look be taken to the cause of the higher levels, and steps taken to prevent numerous elevations. **While the system is able to automatically shut down, if the high elevations persist for a period of time, recycling and holding capacities could be exceeded.** Also, some lesser quality effluent is probably discharged during the time that the TSS levels go up and the recirculation begins.

The staff was generally knowledgeable of the system. We would recommend that training certificates be obtained for all staff that work with the system and as new staff cover the system, that they too achieve **appropriate training.**

It is recommended that the UV sleeves be hand-cleaned per manufacturer's recommendations. This practice may be increasingly important as the bulbs' intensity decreases with age. It is recommended that the ship carry more replacement bulbs on board. Having a sufficient number of replacement bulbs is necessary in case of failures.

Notification procedures for MOU noncompliance should be known and easily available by all relevant staff including the system operators and staff making the notifications. Norwegian Cruise Lines should pass the word on about the notification phone # and protocol to all NCL ships that travel to Washington waters.

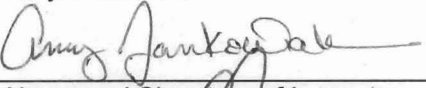
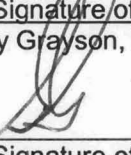

Attachments:

- Photographs
- Ship particulars
- Safety Management Certificate
- Sampling Results Report

Copies to:

- Randy Fiebrandt, NCL
- Bjorn Foss, NCL
- Gilbert Ramirez, NCL
- Magnus Sjosvard, NCL
- Amy Jankowiak, Ecology
- Captain Guy Grayson, Ecology
- John Williams, Ecology
- Frank Meriwether, Health
- Kevin Fitzpatrick, Ecology
- Central Files: Norwegian Cruise Lines - NORWEGIAN DREAM; WQ 6.1

Section H: Signatures

<u>Name and Signature of Inspector</u> Amy Jankowiak 	<u>Agency/Office/Telephone</u> Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	<u>Date</u> 08-08-05
<u>Name and Signature of Inspector</u> Captain Guy Grayson, BSc, MNI 	<u>Agency/Office/Telephone</u> Department of Ecology/Puget Sound Field Office/Spills Program/Prevention Section/Vessel Inspector/360-407-6761	<u>Date</u> 08-10-05
<u>Name and Signature of Reviewer</u> Kevin C. Fitzpatrick 	<u>Agency/Office/Telephone</u> Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649- 7033	<u>Date</u> 8-22-05



State of Washington Department of Ecology
**Verification of Operating Conditions
of Advanced Wastewater Treatment
Systems for Cruise Ship Discharges**

Northwest Regional Office
3190 160th Ave SE
Bellevue, WA 98008
Phone: (425) 649-7000 Fax: (425) 649-7098

Section A: General Information

Vessel Name:	NORWEGIAN SPIRIT	Date:	September 10, 2005
Vessel Operator:	NCL (Bahamas) Ltd.	Entry Time:	9:34 am
IMO Number:	9141065	Exit Time:	11:58 am
Vessel Type:	Passenger Ship	Notification (name & date):	Randy Fiebrandt/Eric Wolff 9/7/05
Location:	Pier 66, Seattle	On-board contact(s):	Sue Lobo, Environmental Officer; Tor Havaas, Staff Chief Engineer; Wilfredo Gumapal, wastewater system operator
Inspector(s):	Amy Jankowiak, Department of Ecology; Kevin Fitzpatrick, Department of Ecology; Frank Meriwether, Department of Health – Shellfish Program		
# passengers/crew:	Actual: ~2200/~900	Amount of Wastewater Influent:	Actual: approximately 18 m ³ /hr or Max: 1000 m ³ /day
		Obtain copy of SMC:	<input checked="" type="checkbox"/>

Description of advanced wastewater treatment system (name, type, major components, etc.):

Scanship is a biological reactor and ultrafiltration system. The system includes prefiltration, biological treatment via a biofilm process, chemical precipitation, clarification through flotation tanks, polishing filtration and UV disinfection. Approval for continuous discharge from Ecology was granted on August 12, 2004.

Section B: Areas Evaluated

<input checked="" type="checkbox"/> Black/Gray wastewater system	<input checked="" type="checkbox"/> Operations Center/ Computer system	<input checked="" type="checkbox"/> Records/Reports	<input checked="" type="checkbox"/> Sampling/Monitoring
<input checked="" type="checkbox"/> Discharge locations	<input checked="" type="checkbox"/> Operations & Maintenance	<input checked="" type="checkbox"/> Sludge Handling/Disposal	<input checked="" type="checkbox"/> Other

Section C: For vessels discharging ≥ 1 nm from berth and ≥ 6 knots only

<input type="checkbox"/> Schematics match black/gray wastewater system	Not Applicable
<input type="checkbox"/> Sludge disposal protocol per MOU	Not Applicable
<input type="checkbox"/> Notification procedures (for contacting Ecology of non-compliance) in place	Not Applicable

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

<input checked="" type="checkbox"/> Schematics match black/gray wastewater system	System is as depicted in schematics
<input checked="" type="checkbox"/> Sludge disposal protocol per MOU	Discharges about twice per week, 12 nm out and not in the Olympic Coast National Marine Sanctuary and some sludge is disposed of via the incinerator.
<input checked="" type="checkbox"/> Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	The Environmental Officer was not able to find the correct number for notification. I provided a quick reference notification sheet as attached. The notification is required per the MOU. A copy of the current version of the MOU was on the ship and accessible.
<input checked="" type="checkbox"/> Operations as described in submitted documentation	Operations were as described.
<input checked="" type="checkbox"/> Daily 24-hour continuous turbidity or equivalent monitoring	Has continuous TSS monitoring
<input checked="" type="checkbox"/> Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly. Details in narrative.
<input checked="" type="checkbox"/> Turbidity or equivalent	Last calibration: Soon will be receiving a new meter and will send the old one in for calibration. They do compare TSS meter values with samples taken. Frequency of readings: Continuous Trigger level for alarm: 20 mg/l TSS Recorded turbidity/equivalent levels above triggers: No TSS meter was reading 4.8 NTU at time of inspection Trigger level for shutdown: 30 mg/l TSS
<input checked="" type="checkbox"/> Auto shut down or operational	Automatic shutdown appears to be operating properly, but hasn't had to be used.

	controls to insure system shut down if a system upset occurs	
	Ultraviolet (UV) light disinfection immediately prior to discharge	2 UV banks plus one backup run in series for effluent with 14 bulbs each. The UV system runs at about 52-57 watts/m ² .
<input checked="" type="checkbox"/>	UV replacement bulbs available	They currently do not have spares on board, but they have been ordered.
<input checked="" type="checkbox"/>	UV/bulbs cleaned regularly	Auto cleans via water pumping through and a chemical wash of "Metal Bright". The bulbs/sleeves are not hand wiped. Bulbs are replaced based on transmittance.

Section E: General

<input checked="" type="checkbox"/>	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required.
	Whole Effluent Toxicity Testing 1 per 2 years	WET testing not conducted yet. In second season of approval.
<input checked="" type="checkbox"/>	Training up to date for system operators	Scanship conducts training on the ship during start-up of the system. Scanship is also on board periodically. General training is conducted during staff handover (about 2 weeks).
<input checked="" type="checkbox"/>	Discharge records maintained	Maintained properly
<input checked="" type="checkbox"/>	Alarms functioning properly	Alarms appear to be functioning properly.
Alarms Shutdowns: yes High turbidity/TSS warnings: yes High wastewater levels: yes UV disinfection (intensity, bulbs, bank out, power failure): yes (also have an emergency generator)		

Section F: Sample Results

Parameter	Effluent Result
Biochemical Oxygen Demand (5-Day)	4.90 mg/l
Total Suspended Solids (TSS)	Non Detect
Fecal Coliform (MF)	Non Detect
Residual Chlorine (if taken)	Non Detect
pH (if taken)	6.68 Standard Units
Other Turbidity	0.88 at the regular effluent sampling point and 6.98 at the port on overboard A

Laucks Testing Laboratories, Inc was also on board pulling samples and had a temperature reading of 28.3°C with a pH of 6.2 standard units at the effluent sampling point.

Section G: Summary of Findings/Comments

Introduction

Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program (NWRO-WQ), Municipal Compliance Specialist and Kevin Fitzpatrick, Ecology NWRO-WQ, Water Quality Program Section Manager, and Frank Meriwether, Washington State Department of Health – Shellfish Program, Environmental Engineer conducted the inspection on September 10, 2005. The main contacts on board the NORWEGIAN SPIRIT included Sue Lobo, Norwegian Cruise Line (NCL), Environmental Officer, Tor Havaas, NCL, Staff Chief Engineer, and Wilfredo Gumapal, NCL, wastewater system operator. Prior notification of the visit was given on September 7, 2005 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the *Memorandum of Understanding Cruise Operations in Washington State*, as amended. The NORWEGIAN SPIRIT received approval to discharge continuously per the MOU on August 12, 2004.

The NORWEGIAN SPIRIT was built in 2004, and is 881 feet long. There are typically about 2200 passengers and about 950 crew. The ship's wastewater system, Scanship, was installed in May 2004.

Inspection

We arrived boarded the ship at about 9:34 am and began with introductions and a plan for the day. We then headed to the control room where the Scanship system is monitored and we met with Mr. Gumapal, wastewater system operator. Mr. Gumapal walked us through the Scanship wastewater system on the computer (photos #1, #2, #3, #4, and #7). Both Mr. Gumapal and Ms. Lobo seemed very familiar with the system. Mr. Gumapal is basically operating the system or is on call. Other engineers also monitor the system. Scanship conducts training on the ship during start-up of the system. Scanship is also on board periodically. General training is conducted during staff handover (about 2 weeks). The Scanship operates in basically this sequence: prescreening (2 drum screens), biological treatment (biofilm on rotating plastic pieces – 2 tanks in

series), chemical precipitation (flocculants, polymer), clarification via flotation tanks (2 tanks), ultrafiltration via polishing filters (2 rotating mesh drums), and disinfection via ultraviolet light (UV).

An online continuous TSS monitor is used to measure the turbidity of the effluent. While in the control room, the TSS meter was reading 4.8 TSS. An alarm level is set at 20 TSS and another at 30 TSS, which triggers the automatic shutdown of discharges and recycles the flow back through the system. Reportedly, turbidity levels have not exceeded the 30 TSS trigger level for automatic shut down. The TSS monitor will soon be replaced by a new meter and they will send the old one in for calibration. They do compare TSS meter values with samples taken. Ecology recommends that the manufacturer's recommendations for calibration be reviewed and followed. Calibrations should be done per manufacturer's recommendations and at least annually to ensure reliability.

There are three UV units (made by WEDECO AG), of which two were in use at the time and run in series. Each bank has 14 bulbs. Each bank has a design dose of 400 J/m^2 ($400 \text{ watt-seconds/m}^2$, $40 \text{ mw-seconds/cm}^2$) with an assumed transmission of 40% and a design flow rate of $60 \text{ m}^3/\text{hour}$ (260 gpm). Since the typical flow rate is $35 \text{ m}^3/\text{hour}$ (see below) the actual dosage provided should be very effective at inactivating many pathogens. UV intensity during our visit was $\sim 57.5 \text{ W/m}^2$. An alarm is triggered when intensity drops to 16 W/m^2 . There is a transmittance monitor for each of the three banks. Two UV banks are typically used, with one for backup. There is a sampling port immediately prior to each UV bank. Spare bulbs have been ordered and are typically available on the ship, however, there were not any on board at the time of the inspection, while they wait for the order to come in. The UV bulbs/sleeves are washed automatically via a pump wash with a "Metal Bright" solution. There are no wipers for the UV sleeves, and are not hand wiped periodically. Ecology recommends that the manufacturer's recommendations for cleaning the UV be reviewed and followed. Proper cleaning may be increasingly important as the bulbs' intensity decreases with age.

Discharge records were reviewed and are well kept. The "Sewage and Gray Water Discharge Record Book" (photos #5 and #6) includes dates, times, discharge locations, port locations, effluent type, volumes, speed, signatures and remarks. A protocol for discharging including verification of proper locations is used for all discharges.

Sludge from the system (photo #19) is sent to holding tanks and is then discharged at greater than 12 nautical miles from shore and outside of the Olympic Coast National Marine Sanctuary or is sent to the sludge dryer/incinerator.

This ship has one discharge port (A) (photo #15) for treated wastewater, on Deck 1 level, above the bottom of the keel by ~ 25 feet and above the prop shaft by ~ 1 meter. The diameter of this discharge pipe inside the ship is about 10 inches. Each of two props is 5.8 meters in diameter. The distance between waterline and top of prop is generally 2 meters. The shafts for the two props are about 40 feet apart.

A review of notification procedures for unauthorized discharges from the wastewater system was conducted as well. The MOU-required notifications procedures were not readily known by staff during the inspection (The MOU requires "NWCA members to immediately self-report non-compliance with any provision of this MOU to the Department of Ecology at the following 24-hour number: 425-649-7000."). A quick reference notification sheet was provided as attached. The ship has access to the most current version of the amended MOU.

Next, we headed down to the Scanship system itself (photo #8). Mr. Gumapal led us in a very informed tour of the system. Graywater (accommodation, showers, sinks, and galley) is collected in tanks. Laundry gray water is sent directly to the drum screens. Blackwater is collected via vacuum and is also sent directly to the drum screens. The wastewater (black and gray) goes to two drum screens (photos #17 and #18) used for prescreening. From there the liquid is sent to a mixing tank and then onto the biological treatment (two bio tanks with blowers) where plastic pieces do the biological work (photos #21 and #22). Defoamer is added in this process. Then coagulant (photo #24) and polymer (photo #23) are added prior to clarification via two flotation tanks (dispersion air and water – photos #25 and #26) that are on a system that allows the tanks to stay level so as the ship tilts, the tanks remain level. After flotation the liquid goes to one of two polishing filters (photo #27) for ultrafiltration via a mesh screen. From the filters, the liquid goes to the treated water tank and then to the ultraviolet disinfection (photo #28) in three units and is then discharged directly. There are sampling ports at the effluent of the UV as well as at the influent of the UV. Solids are taken from the prefiltration screens and from the flotation units to a sludge tank and the sludge is either held and discharged at greater than 12 nautical miles or is dried and incinerated.

Samples were taken (photos #9, #10, #11, #12, and #13) for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, and fecal coliform from the effluent of the UV disinfection. Mr. Gumapal heated the port prior to sampling for a clean sample. An Ecology turbidity meter was also used to run a turbidity sample right there. The result was 0.88 NTU from the regular sampling port and 6.98 NTU from Port A (overboard point). The samples were put on ice immediately and were transported to North Creek Analytical laboratory in Bothell, Washington that afternoon. Chain of Custody and sampling procedures were followed. All results are in Section F.

The ship has a BioVir virus testing kit (photos #29 and #30) sent by David Wetzel of Admiralty Environmental in case of a

Norovirus illness outbreak.

Conclusions and Recommendations

The Scanship system appears to be functioning well.

The staff was generally knowledgeable of the system. We would recommend that as new staff cover the system, that they receive appropriate training and achieve comparable levels of proficiency.

It is recommended that the notification procedures in the MOU are properly integrated into the ships notification procedures.

It is recommended that the UV sleeves be hand-cleaned per manufacturer's recommendations. This practice may be increasingly important as the bulbs' intensity decreases with age. It is recommended that the ship carry more replacement bulbs on board. Having a sufficient number of replacement bulbs is necessary in case of failures.

In case of a Norovirus illness outbreak, the environmental staff are expected to call David Wetzel for sampling instructions. Dr. Wetzel has informed DOH (Frank Meriwether) that he would suggest to ship staff, that virus sampling include a sampling point immediately prior to UV disinfection.

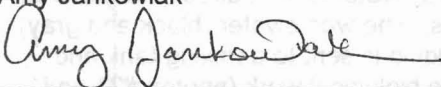
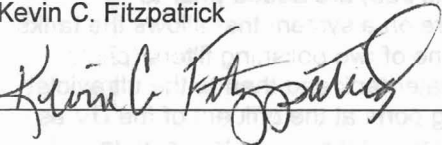
Attachments:


Photographs
Notification Sheet
Ship particulars
Safety Management Certificate
Sampling Results Report

Copies to:

Randy Fiebrandt, NCL
Sue Lobo, NCL, SPIRIT Environmental Officer
Wilfredo Gumapal, NCL, SPIRIT system operator
Tor Havaas, NCL, SPIRIT Staff Chief Engineer
Amy Jankowiak, Ecology
Norm Davis, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Norwegian Cruise Lines - NORWEGIAN SPIRIT; WQ 6.1

Section H: Signatures

<u>Name and Signature of Inspector</u>	<u>Agency/Office/Telephone</u>	<u>Date</u>
Amy Jankowiak 	Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	9/28/05
<u>Name and Signature of Reviewer</u>	<u>Agency/Office/Telephone</u>	<u>Date</u>
Kevin C. Fitzpatrick 	Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	9/28/05

	State of Washington Department of Ecology Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges	Northwest Regional Office 3190 160 th Ave SE Bellevue, WA 98008 Phone: (425) 649-7000 Fax: (425) 649-7098 Puget Sound Field Office 1011 SW Klickitat Way, Suite 211 Seattle, WA 98134 Phone: (206) 389-2431 Fax: (206) 587-5196

Section A: General Information

Vessel Name:	NORWEGIAN STAR	Date:	August 14, 2005
Vessel Operator:	NCL (Bahamas) Ltd.	Entry Time:	12:46 pm
IMO Number:	9195157	Exit Time:	2:45 pm
Vessel Type:	Passenger Ship	Notification (name & date):	Randy Fiebrandt/Eric Wolff 8/11/05
Location:	Pier 66, Seattle	On-board contact(s):	Jan Nilsen, Environmental Officer; Ronne Briones, Operator
Inspector(s):	Amy Jankowiak, Ecology Northwest Regional Office; Norm Davis, Ecology - Puget Sound Field Office		
# passengers/crew:	Actual: ~2600/~1100	Amount of Wastewater:	Yesterday: 40-50 m ³ /hr
			Obtain copy of SMC: <input checked="" type="checkbox"/>

Description of advanced wastewater treatment system (name, type, major components, etc.):
 Scanship is a biological reactor and ultrafiltration system. The system includes prefiltration, biological treatment via a biofilm process, chemical precipitation, clarification through flotation tanks, polishing filtration and UV disinfection. Approval for continuous discharge from Ecology was granted on August 12, 2004.

Section B: Areas Evaluated

<input checked="" type="checkbox"/>	Black/Gray wastewater system	<input checked="" type="checkbox"/>	Operations Center/ Computer system	<input checked="" type="checkbox"/>	Records/Reports	<input checked="" type="checkbox"/>	Sampling/Monitoring
<input checked="" type="checkbox"/>	Discharge locations	<input checked="" type="checkbox"/>	Operations & Maintenance	<input checked="" type="checkbox"/>	Sludge Handling/Disposal	<input checked="" type="checkbox"/>	Other (bunkering)

Section C: For vessels discharging ≥ 1 nm from berth and ≥ 6 knots only

<input type="checkbox"/>	Schematics match black/gray wastewater system	Not Applicable
<input type="checkbox"/>	Sludge disposal protocol per MOU	Not Applicable
<input type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance) in place	Not Applicable

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

<input checked="" type="checkbox"/>	Schematics match black/gray wastewater system	System is as depicted in schematics
<input checked="" type="checkbox"/>	Sludge disposal protocol per MOU	Discharges 12 nm out or via incinerator.
<input checked="" type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	The Environmental Officer was able to find the correct number for notification. I also provided him with a quick reference notification sheet as attached.
<input checked="" type="checkbox"/>	Operations as described in submitted documentation	Operations were as described.
<input checked="" type="checkbox"/>	Daily 24-hour continuous turbidity or equivalent monitoring	Has continuous TSS monitoring
<input checked="" type="checkbox"/>	Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly. Details in narrative.
	<u>Turbidity or equivalent</u> Last calibration: Not sure – they clean it when something is wrong Frequency of readings: Continuous Trigger level for alarm: 28 mg/l TSS Recorded turbidity/equivalent levels above triggers: Yes Trigger level for shutdown: 30 mg/l TSS	
<input checked="" type="checkbox"/>	Auto shut down or operational controls to insure system shut down if a system upset occurs	Automatic shutdown appears to be operating properly.
<input checked="" type="checkbox"/>	Ultraviolet (UV) light disinfection immediately prior to discharge	3 UV banks run in series for effluent with 15 bulbs each. There is a holding tank

		available after UV. Flow that goes to the holding tank is only discharged if then receives UV through a 4 th UV unit.
<input checked="" type="checkbox"/>	UV replacement bulbs available	Approximately 1 units worth of spares on board.
<input checked="" type="checkbox"/>	UV/bulbs cleaned regularly	Auto cleans every so many hours (approximately once/week) via water pumping through and a chemical wash. They sometimes hand wipe.

Section E: General		
<input checked="" type="checkbox"/>	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required.
<input checked="" type="checkbox"/>	Whole Effluent Toxicity Testing 1 per 2 years	WET testing not conducted yet. In second season of approval.
<input checked="" type="checkbox"/>	Training up to date for system operators	Scanship conducts training on the ship during start-up of the system (about 10 days). A certificate is issued to those trained.
<input checked="" type="checkbox"/>	Discharge records maintained	Maintained properly
<input checked="" type="checkbox"/>	Alarms functioning properly	Alarms appear to be functioning properly.
	Alarms Shutdowns: yes High turbidity/TSS warnings: yes High wastewater levels: yes UV disinfection (intensity, bulbs, bank out, power failure): yes (also have an emergency generator and batteries for power outages)	

Section F: Sample Results		
	Parameter	Effluent Result
	Biochemical Oxygen Demand (5-Day)	35.9 mg/l
	Total Suspended Solids (TSS)	4.5 mg/l
	Fecal Coliform (MF)	Non Detect
	Residual Chlorine (if taken)	0.0250 mg/l
	pH (if taken)	6.67 Standard Units
	Other Turbidity	2.22 NTU

Section G: Summary of Findings/Comments
<p>Introduction</p> <p>Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist and Norm Davis, Ecology, Puget Sound Field Office conducted the inspection on August 14, 2005. The main contacts on board the NORWEGIAN STAR included Jan Nilsen, Environmental Officer; Ronne Briones, the main wastewater system operator. Prior notification of the visit was given on August 11, 2005 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the <i>Memorandum of Understanding Cruise Operations in Washington State</i>, as amended. The NORWEGIAN STAR received approval to discharge continuously per the MOU on August 12, 2004. A review of bunkering was also conducted by Norm Davis.</p> <p>The NORWEGIAN STAR was built in 2001, is 965 feet long with 15 guest decks, with about a 28-foot draft. Passenger capacity is 4080 total passenger berths. There are typically about 2600 passengers and 1100 crew. It is my understanding that the ship's wastewater system, Scanship, was installed in 2004.</p> <p>Inspection</p> <p>We arrived boarded the ship at about 12:46 pm and began with introductions and a plan for the day. A review of notification procedures for unauthorized discharges from the wastewater system was conducted as well. Mr. Jan Nilsen, the Environmental Officer was able to correctly identify the appropriate number to call (The MOU requires "NWCA members to immediately self-report non-compliance with any provision of this MOU to the Department of Ecology at the following 24-hour number: 425-649-7000."). A quick reference notification sheet was also provided as attached. The ship has access to the most current version of the amended MOU.</p> <p>We headed to the control room where the Scanship system is monitored and we met with Mr. Ronne Briones, wastewater system operator. Mr. Briones walked us through the Scanship wastewater system on the computer. Both Mr. Briones and Mr. Nilsen seemed very familiar with the system. Mr. Briones is basically operating the system or is on call. Other engineers also monitor the system. Scanship conducts training on the ship during start-up of the system (about 10 days). A certificate is issued to those trained. The Scanship operates in basically this sequence: prescreening (2 drum screens), biological</p>

treatment (biofilm on rotating plastic pieces – 2 tanks in series), chemical precipitation (flocculants, polymer), clarification via flotation tanks (2 tanks), ultrafiltration via polishing filters (2 rotating mesh drums), and disinfection via ultraviolet light (UV).

An online continuous TSS monitor is used to measure the turbidity of the effluent. An alarm level is set at 28 TSS and another at 30 TSS, which triggers the automatic shutdown of discharges and recycles the flow back through the system. The last calibration date was not known. Ecology recommends that the manufacturer's recommendations for calibration be reviewed and followed. Calibrations should be done per manufacturer's recommendations and at least annually to ensure reliability.

There are four UV units, three for effluent from the permeate tank and one for effluent from the effluent holding tank. The MOU requires UV disinfection immediately prior to discharge. There is approximately one unit's worth of spare UV bulbs available on the ship. The UV bulbs/sleeves are washed automatically via a pump wash with a "Metal Bright" solution. There are no wipers for the UV sleeves, but they are hand wiped periodically. Ecology recommends that the manufacturer's recommendations for cleaning the UV be reviewed and followed. Proper cleaning may be increasingly important as the bulbs' intensity decreases with age.

Discharge records (photo # 2) were reviewed and are well kept. The records include dates, times, discharge locations, port locations, effluent type, volumes, speed, signatures and remarks. A discharge location plan (photo # 1) is followed as well as the protocol for discharging including verification of proper locations.

Sludge from the system is sent to holding tanks and is then discharged at greater than 12 nautical miles from shore or is sent to the incinerator. Scanship representatives were on board the day of the inspection working on the drying and incineration. Per the MOU, the discharge of sludge is also prohibited within the "Area To Be Avoided" off the Washington Coast in the Olympic Coast National Marine Sanctuary.

Next we looked at some of the areas of potential waste streams. Garbage and recycling is separated (photo # 3) and sent to shore. Hazardous wastes are also labeled, collected, stored (photo # 4), and then sent to shore for proper disposal. The photo area uses a silver recovery system (photo # 5) and the wastes are collected and sent to shore. Laundry uses detergents (photo # 6) and dry cleaning uses PERC (photo # 7) which is also collected with the hazardous wastes and sent to shore. The medical facility has wastes such as x-ray chemicals (photo # 8 which were not yet labeled properly), sharps, blood and other wastes (photo # 9; which are collected in special red containers for proper disposal to shore).

We then headed down to the Scanship system itself. Mr. Briones led us a very informed tour of the system. Graywater and blackwater from the ship are collected in a tank - mixed. The wastewater is pumped (photo # 10) to two drum screens (photos # 11 and # 12) used for prescreening. The screens are cleaned manually with water about once a week. From there the liquid is pumped (photo # 13) to the biological treatment (two bio tanks) where plastic pieces do the biological work (photos # 14, #15, and # 17). A defoamer (photo # 16) is used at the 1st bio tank. Then coagulant and polymer (photos # 21 and # 22) are added prior to clarification via two flotation tanks (photos # 18, # 19, and # 20) that are on a system that allows the tanks to stay level so as the ship tilts, the tanks are essentially still. After flotation the liquid goes to one of two polishing filters (photos # 23 and # 24) for ultrafiltration via a mesh screen. The filters are also cleaned manually with water about once a week. From the filters, the liquid goes to the ultraviolet disinfection via three units (photo # 25) and is then typically discharged directly. Some effluent goes to a holding tank and then through a 4th UV unit (photo # 26) prior to discharge (photo # 27). There are sampling ports at the effluent of the UV (photo # 28). Solids are taken from the prefiltration screens and from the flotation units to a sludge tank and the sludge is either held and discharged at greater than 12 nautical miles or is dried and incinerated.

Samples were taken (photo # 29) for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, and fecal coliform from the effluent of the UV disinfection. Mr. Briones heated the port prior to sampling for a clean sample. An Ecology turbidity meter was also used to run a turbidity sample right there. The result was 2.22 NTU. The samples were put on ice immediately and were transported to North Creek Analytical laboratory in Bothell, Washington that afternoon. Chain of Custody and sampling procedures were followed. All results are in Section F.

Conclusions and Recommendations

The Scanship system appears to be functioning well. The automatic shutdown during high TSS levels appears to be functioning properly.

The staff was generally knowledgeable of the system. We would recommend that as new staff cover the system, that they receive appropriate training and achieve comparable levels of proficiency.

It is recommended that the UV system cleaning procedures be reviewed and that cleaning be done per manufacturer's recommendations.

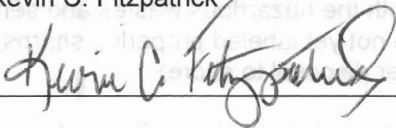
Attachments:

Photographs
Notification Sheet
Ship particulars
Safety Management Certificate
Sampling Results Report

Copies to:

Randy Fiebrandt, NCL
Jan Nilsen, Environmental Officer
Ronne Briones, Operator
Amy Jankowiak, Ecology
Norm Davis, Ecology
Frank Meriwether, Health
Kevin Fitzpatrick, Ecology
Central Files: Norwegian Cruise Lines - NORWEGIAN STAR; WQ 6.1

Section H: Signatures

<u>Name and Signature of Inspector</u>	<u>Agency/Office/Telephone</u>	<u>Date</u>
Amy Jankowiak	Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	9/15/
<u>Name and Signature of Reviewer</u>	<u>Agency/Office/Telephone</u>	<u>Date</u>
Kevin C. Fitzpatrick 	Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649- 7033	9/15/05

State of Washington Department of Ecology

Verification of Operating Conditions of Advanced Wastewater Treatment Systems for Cruise Ship Discharges

Northwest Regional Office
3190 160th Ave SE
Bellevue, WA 98008
Phone: (425) 649-7000 Fax: (425) 649-7098

Puget Sound Field Office
1011 SW Klickitat Way, Suite 211
Seattle, WA 98134
Phone: (206) 389-2431 Fax: (206) 587-5196

Section A: General Information

Vessel Name:	SAPPHIRE PRINCESS		Date:	August 14, 2005	
Vessel Operator:	Princess Cruises		Entry Time:	8:55 am	
IMO Number:	9228186		Exit Time:	11:50 am	
Vessel Type:	Passenger Ship		Notification (name & date):	Charlie Ball/Dan Heverly 8/11/05	
Location:	Terminal 30, Seattle		On-board contact(s):	Tore Drydal, Environmental Officer; Alessandro Sclafani, Staff Engineer Officer	
Inspector(s):	Amy Jankowiak (Ecology, Northwest Regional Office), Norm Davis (Ecology, Puget Sound Field Office)				
# passengers/crew:	Actual: ~2600/1200	Amount of Wastewater:	About 440m ³ /day on average to Hamworthy	Obtain copy of SMC:	<input type="checkbox"/>

Description of advanced wastewater treatment system (name, type, major components, etc.):

Hamworthy is a biological reactor and ultrafiltration system. The system includes screening via a filter press, biological treatment via bio-reactors with inter-stage filters and a membrane system, and ultraviolet light disinfection. The system was installed in May of 2004.

Approval for continuous discharge from Ecology was granted on May 5, 2005.

Section B: Areas Evaluated

<input checked="" type="checkbox"/>	Black/Gray wastewater system	<input checked="" type="checkbox"/>	Operations Center/ Computer system	<input checked="" type="checkbox"/>	Records/Reports	<input checked="" type="checkbox"/>	Sampling/Monitoring
<input checked="" type="checkbox"/>	Discharge locations	<input checked="" type="checkbox"/>	Operations & Maintenance	<input checked="" type="checkbox"/>	Sludge Handling/Disposal	<input checked="" type="checkbox"/>	Other (bunkering)

Section C: For vessels discharging ≥ 1 nm from berth and ≥ 6 knots only

<input type="checkbox"/>	Schematics match black/gray wastewater system	Not Applicable
<input type="checkbox"/>	Sludge disposal protocol per MOU	Not Applicable
<input type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance) in place	Not Applicable

Section D: For vessels discharging continuously (at berth or within 1 nm of berth)

<input checked="" type="checkbox"/>	Schematics match black/gray wastewater system	System appears to be as depicted in schematics.
<input checked="" type="checkbox"/>	Sludge disposal protocol per MOU	Yes. Sludge incinerated or held for discharge at greater than 12 nautical miles.
<input type="checkbox"/>	Notification procedures (for contacting Ecology of non-compliance and for system shut down) in place	Notification procedures were not clear. They did not know the correct number to call. Information has been provided.
	Operations as described in submitted documentation	Operations appeared to be as described in submitted documentation.
<input checked="" type="checkbox"/>	Daily 24-hour continuous turbidity or equivalent monitoring	Continuous turbidity monitoring
<input checked="" type="checkbox"/>	Turbidimeter or equivalent monitoring equipment functioning properly	Appears to be functioning properly.
	<u>Turbidity or equivalent</u> Last calibration: beginning of June, 2005 Frequency of readings: continuous Trigger level for alarm: 30 NTU Recorded turbidity/equivalent levels above triggers: No	
<input checked="" type="checkbox"/>	Auto shut down or operational controls to insure system shut	Has not yet had alarm level reached, but protocol in place.

	down if a system upset occurs	
<input checked="" type="checkbox"/>	Ultraviolet (UV) light disinfection immediately prior to discharge	Yes. 1 bank.
<input checked="" type="checkbox"/>	UV replacement bulbs available	Yes. 1 st 2000 hours (4), then more bulbs, lamps. Has 11 total spares on board.
<input checked="" type="checkbox"/>	UV/bulbs cleaned regularly	Yes. Cleaning is done automatically and manually via sop and cloth cleaning of the outside glass as necessary and at least once a month.

Section E: General		
<input checked="" type="checkbox"/>	Sampling conducted 2/month, 1/month in Seattle (BOD, TSS, fecal coliform, pH, chlorine residual)	As of the date of the inspections, sampling has been conducted as required.
	Whole Effluent Toxicity Testing 1 per 2 years	WET testing not conducted yet. This is the 1 st year of approval.
	Training up to date for system operators	Training conducted by Hamworthy or via manuals and staff training. If not on the ship for a while, refreshers are conducted.
<input checked="" type="checkbox"/>	Discharge records maintained	Maintained properly.
<input checked="" type="checkbox"/>	Alarms functioning properly	Alarms appear to be functioning properly.
<u>Alarms</u> Shutdowns: Yes High turbidity warnings: Yes High wastewater levels: Yes UV disinfection (intensity, bulbs, bank out, power failure): No. working on. If the UV is having problems, will discover via weekly checks or temperature changes.		

Section F: Sample Results		
	Parameter	Effluent Result
	Biochemical Oxygen Demand (5-Day)	Non Detect
	Total Suspended Solids (TSS)	Non Detect
	Fecal Coliform (MF)	Non Detect
	Residual Chlorine (if taken)	0.0360 mg/l
	pH (if taken)	7.21 Standard Units
	Other Turbidity	0.4 NTU

Section G: Summary of Findings/Comments
<p><u>Introduction</u></p> <p>Amy Jankowiak, Washington State Department of Ecology (Ecology) Northwest Regional Office, Water Quality Program, Municipal Compliance Specialist and Norm Davis, Ecology, Puget Sound Field Office, conducted the inspection on August 14, 2005. The main contacts on board the SAPPHIRE PRINCESS included Tore Drydal, Environmental Officer and Alessandro Sciafani, Staff Engineer Officer. Prior notification of the visit was given on August 11, 2005 for security protocol. The purpose of the inspection was to evaluate the operating conditions of Advanced Wastewater Treatment System (AWTS) for cruise ship discharges per the <i>Memorandum of Understanding Cruise Operations in Washington State</i>, as amended. Samples were also collected as per the MOU. The SAPPHIRE PRINCESS received approval to discharge continuously per the MOU on May 5, 2005.</p> <p>The SAPPHIRE PRINCESS (photo # 1 and # 2) was built in May 2004. It is 951 feet long with 16 decks. Passenger volume is typically about 2600 and 1200 crew, although can hold more. The ship's wastewater system, Hamworthy, was installed at the time the ship was built in May of 2004.</p> <p><u>Inspection</u></p> <p>We arrived boarded the ship at about 8:55am and began with introductions and a plan for the day. A review of notification procedures for unauthorized discharges from the wastewater system was conducted. The Environmental Officer was unaware of the correct phone number to contact for such discharges. The MOU requires "NWCA members to immediately self-report non-compliance with any provision of this MOU to the Department of Ecology at the following 24-hour number: 425-649-7000." The correct phone number was given to the Environmental Officer and a notification sheet is attached as well. The Environmental Officer suggested that they update the notification requirements in their SMS System – fleet regulation so that it is easily available. They also only had the original version of the MOU on board. We provided an electronic version of the amended MOU which was promptly added to the Environmental Officer's computer.</p>

We headed to the control room where the Hamworthy system is monitored from. Alesandro Sclafani is one of the main system operators. Other engineers also monitor the system. Staff also maintain the system including cleaning, changing filters, etc. Training was initially done during the start-up of the plant and Hamworthy technicians also are on board from time to time for assistance. Training is also done via manuals, staff training and refreshers. The Hamworthy computer system allows for monitoring, alarms, and system operational changes. The Hamworthy system operates in basically this sequence: screening via filter press, biological treatment via the bio-reactor with an inter-stage filter, ultrafiltration via the membrane system, and disinfection with ultraviolet light.

Accommodation graywater is collected in four different tanks. The membrane system intakes some of this flow. Laundry has two tanks and galley has 9 tanks, which are not sent to the membrane system, but are held and then discharged outside of 12 nautical miles. Blackwater is sent via vacuum to 5 different tanks prior to going to the Hamworthy system. The Hamworthy system treats blackwater primarily and only pulls graywater if the levels allow for it. One of 3 Hamworthy systems pulls the blackwater and sometimes graywater into the system to the filter screen press. At the time of the inspection, they were using all three systems, but typically have the capacity and ability to stop one of the systems for maintenance, etc. Liquid from the filter screen press goes to the 1st stage of the bioreactor. Solids from the filter screen press are collected in bags and sent to the incinerator. Liquid from the 1st stage of the bioreactor goes to inter-stage screening. Solids collected there are sent to the inlet of the filter screen press. Liquids go on to the 2nd stage of the bioreactor. From there the liquid is pumped to the membranes. They do have some spare membranes on the ship (photo # 15). From the membranes, flow goes to a permeate collection tank and then onto holding tanks or ultraviolet disinfection (UV) and is then discharged. The SAPHIRE PRINCESS is discharging while in Washington waters per their continuous discharge approval. A procedure is followed which includes verifying from the bridge proper locations for discharges (photo # 3).

Turbidity is measured via a continuous meter located at the effluent of the membranes. An alarm is set for shutdown of the system at 30 NTU. The system can not reset until the turbidity is lower. The system does not automatically shutdown, however has operational control measures to ensure shutdown discharges from the system when the alarms go off. They have not yet reached the alarm level. The Turbidimeter was last calibrated in June. The turbidity readings at the time that we were reviewing the control room computer systems read:

- 3.2 NTU in system no.1;
- 0.1 NTU in system no.2; and
- 0.1 NTU in system no. 3.

Other system monitoring includes daily tests for DO, pH and temperature; weekly tests for temperature, pH, chlorine, TSS, coliform, e-coli and COD. External sampling by an outside laboratory is conducted weekly. The ship has its own laboratory where some of the analysis can be run. Coliform testing is done on the ship. The coliform is typically less than 10. This attention to process control is commendable. There are alarms for turbidity and high tank levels, but not for UV disinfection. They are working on alarms for the UV, but for the time rely on weekly checks and temperature monitoring.

The ultraviolet light disinfection system (UV) includes 1 unit with 6 tubes and 6 bulbs. They have about 11 spare bulbs available as replacements. There were 4 bulbs in service for the 1st 2000 hours, then more bulbs were added as more hours went into service. Bulbs are replaced on a schedule – preventative. Approximately monthly, the outside glass is cleaned manually via wipe down with soap and cloths. Ecology would recommend reviewing the UV system manufacturer's recommendations for cleaning the UV system to be sure to prevent build-up.

Discharge records (photo # 4) were reviewed and are well kept. The records include dates, times, discharge locations, port locations, effluent type, volumes, speed, signatures and remarks.

Next, we headed to the medical facility to look at any potential wastes. None of the medical wastes (sharps, blood, x-ray – all digital, other materials) are sent to the Hamworthy system or are discharged. All wastes are collected and sent to shore for proper disposal. There have not been any norovirus outbreaks this season on the ship. Non-contact hand cleaning dispensers are reportedly located in various places on the ship. The dry cleaning process uses PERC which is collected (photo # 32) and sent to shore as hazardous waste. Photo waste is also collected and sent to shore. They have a mix of digital photography and regular film photography without a silver recovery system. Sodium bisulphite and sodium hypochlorite (photo # 16) are stored in containment for pool use.

Next we headed down to the Hamworthy system itself. Mr. Sclafani led us in a very thorough and informed tour of the system. Blackwater is collected via vacuum to tanks (photos # 6, # 7, # 9, # 24, and # 25). A defoamer (photos # 8 and # 16) is used in various locations throughout the process. Accommodation graywater is collected into separate tanks (photo # 26). Some of the graywater is treated with chlorine (photo # 27) prior to discharge outside of 12 nautical miles. Gray water then goes to a buffer tank (photo # 5). The blackwater and graywater are combined just prior to the filter screen press (photo #20 and # 23)). Solids from the filter screen pressed are bagged (photo # 21), and the bags are replaced about every 4

hours. Spare filter screen press mesh filters are on the ship (photo # 22). The bags are taken to the incinerator (photo # 31) for incineration. The liquids move onto the 1st stage of the bioreactor. Flow then moves to the inter-stage filters (photos # 17, and # 18) before moving to the 2nd stage of the bioreactor. Solids from these filters (photo # 19) are sent back to the inlet to the filter screen press. Liquid from the 2nd stage of the bioreactor is pumped to the membranes (photo # 10). The membranes have a clear area at the top for viewing (photo # 12). The membranes can be cleaned via a homemade cleaner (photo # 14). Turbidity is measured at the effluent of the membranes (photo # 13). From there, flow goes to a permeate collection tank (photo # 28) prior to the UV disinfection (photo # 29). Monitoring and control of the system can be done at the system (photo # 11) as well as in the control room.

Samples were taken for Biochemical Oxygen Demand (BOD 5-Day), Total Suspended Solids (TSS), pH, chlorine residual, and fecal coliform from the effluent of the UV disinfection (photo # 30). An Ecology turbidity meter was also used to run a turbidity sample right there. The result was 0.4 NTU. The samples were put on ice immediately and were transported to North Creek Analytical laboratory in Bothell, Washington that afternoon. Chain of Custody and sampling procedures were followed. All results are in Section F.

Conclusions and Recommendations

The Hamworthy system appears to be functioning very well. The ship apparently has not had any turbidity levels requiring the shutdown of the discharges, but has a protocol to do so if needed.

The staff was generally knowledgeable of the system. We would recommend that as new staff cover the system, that they receive appropriate training and achieve comparable levels of proficiency.

It is recommended that the UV system cleaning procedures be reviewed and that cleaning be done per manufacturer's recommendations. This practice may be increasingly important as the bulbs' intensity decreases with age.

A copy of the most current MOU should be readily available to all staff, and has since been provided by Ecology. Notification procedures for MOU noncompliance should be known and easily available by all relevant staff including the system operators and staff making the notifications. Notification information was provided. Princess Cruises should pass the word on about the notification phone # and protocol to all Princess ships that travel to Washington waters and/or update the SEMS system fleet procedures with the notification protocol.

Attachments:

Photographs

Notification sheet

Sampling Results Report

Copies to:

George Wright, Princess Cruises

Charlie Ball, Princess Cruises

Tore Drydal, Environmental Officer

Alessandro Sclafani, Staff Engineer Officer

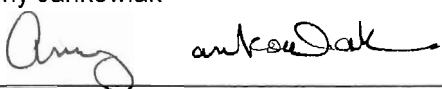
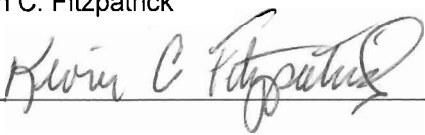
Amy Jankowiak, Ecology

Norm Davis, Ecology

Frank Meriwether, Health

Kevin Fitzpatrick, Ecology

Central Files: Princess Cruise Line – SAPPHIRE PRINCESS; WQ 6.1

Section H: Signatures		
<u>Name and Signature of Inspector</u> Amy Jankowiak 	<u>Agency/Office/Telephone</u> Department of Ecology/Northwest Regional Office/Water Quality Program/Municipal Compliance Specialist/(425) 649-7195	<u>Date</u> 9/15/05
<u>Name and Signature of Reviewer</u> Kevin C. Fitzpatrick 	<u>Agency/Office/Telephone</u> Department of Ecology/Northwest Regional Office/Water Quality Section Manager/(425) 649-7033	<u>Date</u> 9/15/05